
Bulletin of the Atomic Scientists

ISSN: 0096-3402 (Print) 1938-3282 (Online) Journal homepage: https://www.tandfonline.com/loi/rbul20

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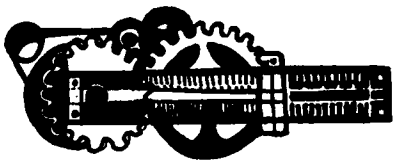
**To cite this article:** Karl T. Compton (1948) Science and Security, Bulletin of the Atomic Scientists, 4:12, 373-376, DOI: 10.1080/00963402.1948.11460276

**To link to this article:** https://doi.org/10.1080/00963402.1948.11460276

# SCIENCE AND SECURITY

*Karl T. Compton*



Dr. Compton made the following speech at the 75th anniversary celebration of Ohio State University on October 15. Dr. Compton has recently resigned as President of Massachusetts Institute of Technology and now succeeds Dr. Vannevar Bush as Chairman of the Research and Development Board of the National Military Establishment.

We have now a far greater public awareness than ever before of the value of pure and applied science to our economy. Many facts demonstrate this. One is found in the budgets for scientific research in our universities. I have no up-to-date over-all figures on this item but I know that our higher educational institutions were spending about $30,000,000 per year on research just before the war, and I believe the figure is now double that, though a large part of it is now coming through government contracts and industrial grants.

On the industrial research side are the following figures which are found in a recent bulletin from Stanford Research Institute. In 1915 there were 100 industrial research laboratories, employing 3,000 people; in 1920 there were 300 laboratories, employing 9,300 people; in 1946 there were 2,500 laboratories, employing 133,500 people. The annual research and development expenditures by industry, as listed in the Steelman Report, *Science and Public Policy*, increased from $116,000,000 in 1930 to $234,000,000 in 1940, and are expected to reach $500,000,000 in 1950.

Governmental expenditures for research and development were $67,000,000 in 1940, and will probably be about $500,000,000 in 1950, according to the Steelman Report. Furthermore, in the last two successive years Congress has almost passed legislation to establish a National Science Foundation, in recognition of the importance to our country of a considerably accelerated program of scientific research, going beyond the capacity or present willingness of private organizations or individuals to carry the desirable full financial responsibility.

It is significant that in public discussions in the press, in Congress, or by national leaders, while there may be disagreement on most other national policies, there seems to be no disagreement with the thesis that the strength and welfare of our country require an active program of research to discover new knowledge and of development to apply this knowledge to meet human needs.

## Allotments for Scientific Research in Government and Industry

One of the most heartening factors recently has been the new look which many important industries are giving to their own opportunities and responsibilities for support of scientific education and research. Some companies have adopted extensive programs of scholarships and fellowships; others have been contributing generously to meet the new scientific and engineering needs of our educational institutions. Many large industrial organizations have appointed committees of their operating officers to review the question of the company's role in these matters and to make appropriate recommendations for more liberal policies. All are simultaneously enlarging their own internal research activities.

In listing these various lines of favorable evidence I should also emphasize the actions which have been taken by many state legislatures to provide new capital facilities and increased operating funds to enable their state universities to play their appropriate role in this increasingly scientific era.

All this is far from saying that the needs and opportunities in science have been completely met. For example, the institution which I serve estimates that $20,000,000 of new capital facilities of buildings, laboratories and equipment, plus $10,000,000 of additional endowment or its equivalent, represent our present really urgent needs for things which are clearly necessary to keep up with the field of technological developments and to carry on the scientific projects which are now clearly defined. $10,000,000 of this has recently been raised; $20,000,000 is still needed. I know that a similar situation, on a larger or a smaller scale, now confronts all of our institutions of higher education.

On the military side the story is very similar. More funds and more activity are found in research and development than ever before in peace-time. For over-all coordination, study and direction there has been established a Research and Development Board, operating directly under the Secretary of Defense. In the post-war effort to cut down expenses of the military establishment, scientific research and development was treated with especial generosity. I have heard it claimed, though I cannot vouch for the literal accuracy of the statement that the Congress has never cut a requested appropriation for research for the Armed Services. Such cuts as have been made in the estimates of needs have been made by the Executive Department and not by Congress. This is certainly true in general, although there may be exceptions, and I think it is significant as an indication of popular recognition of the role of science in our security.

Also new in this whole picture is the tremendous atomic energy program, financed almost completely by public funds, operated principally by industrial companies or educational institutions under the over-all planning and supervision of the Atomic Energy Commission. The stakes here are tremendous, for either peace or war. Undoubtedly the potential development of atomic energy is still in its infancy. Someone has described our present status of atomic power as about equivalent to that of steam power when James Watt first noticed that the steam lifted the lid on his mother's tea kettle.

## Diminishing Natural Resources Are a Challenge to Science

But over and beyond the considerations of security which involve concentration on problems of the near future — problems like full employment for security of jobs, business prosperity for security of standards of living, and military preparedness

in these troubled times for security against international aggression—there is another aspect of security which is beginning to loom on the horizon. It is a long term problem which affects the entire human race and which is causing great anxiety among the relatively few who have given expert thought to the problem but is beginning to come into public consciousness. I refer to the problem created by rapidly increasing populations on the one hand, and the steady exhaustion of those natural resources of soil, minerals and fresh water on which the human race depends for its existence. Books like Fairfield Osborn's *Our Plundered Planet* are beginning to come out to portray the stark inevitability of a catastrophe which may not be many generations off unless some very strenuous measures are taken to prevent it. We already know, for example, that approximately one-third of the soil fertility of our United States has been lost by erosion or by failure to replenish in the soil those essential elements which are extracted from it by repeated crops. We know that this is the process which was basically responsible for the decline and fall of ancient empires in Egypt and the Middle East. We know that it is presently a desperate problem in the highly populated and long inhabited regions of Asia. We know that there is very little leeway in the future for meeting this problem by the discovery and exploitation of presently primitive areas. I have been told, just to take one example, that the supply of lead which is believed to be economically available will be exhausted within about ten years at the present rate of consumption. There has been extraordinary success in the discovery of new oil fields but we all know that this cannot continue forever. Even the present populations and the demands of our modern civilization for fresh water are exhausting the supply more rapidly than it is replenished over very large areas of our own country.

This is probably the most important fundamental problem which is facing the human race. It is partly a sociological problem but it is equally importantly a scientific problem because, basic to any social or political actions, must be first scientific analysis of the problem and the technological development of substitutes for depleted materials, and the discovery of methods for using those materials which we still have far more intelligently and efficiently than they are being used at present. One person has expressed this problem by saying that "it is no longer a question of natural resources but of intelligent resourcefulness."

Therefore, while we are immersed in a consideration of our present economic, political and international problems, and concerned with our security on all of these fronts, there looms in the background with an importance which becomes greater with the passage of every year, this greatest of security problems and challenges to science, namely, the ultimate safety of the human race and the threat of its decline, even down to the stage of a bare struggle for existence on this planet.

## Limiting Factors in Scientific Development

What I have said about the significance of science to our economy and to our military security is well known, and I have mentioned these points only for background and for emphasis on their importance. Let me speak now of the other side of the picture. What are some of the things, other than lack of funds adequate for the work in sight, which are standing in the way of our ability quickly to reap the potential benefits from science?

The first of these limiting factors is the shortage of qualified scientists to carry on effectively the research programs which can now be clearly outlined, and of adequately competent development engineers to carry forward the desirable practical applications based on this scientific progress. The field of nuclear science and atomic energy is the most outstanding example of this shortage. There are exciting new developments in the field of medicine and nutrition which present clear opportunities far beyond the ability of the men presently trained in these fields to exploit promptly. Many other examples might be cited. This is a limitation of which our educational institutions are acutely aware, because we encounter it in our attempts to recruit adequate teaching staffs, and we also encounter it in the demands which are made upon us by industrial and governmental organizations to recommend graduates competently prepared to undertake the various tasks in the governmental and industrial development programs.

Much is being done to meet this emergency. The fact that our educational institutions are crowded to capacity is one bit of evidence. The way in which various governmental agencies, like the Atomic Energy Commission and the Office of Naval Research, and also various forward-looking industries, are making funds available to our educational institutions for research, permits these institutions to employ promising young men and thereby not only to carry on the desired research, but in the same process to develop a more numerous group of highly qualified scientific workers. This is one of the most encouraging aspects of the present situation.

In spite of these favorable factors, however, we are not meeting the demand as effectively as we might. Many of our educational institutions are limited seriously in what they can do by the lack of major facilities which are necessary to tackle effectively the problems in some of the newly developing technological fields. On the human side, as distinct from physical facilities, many surveys have indicated that we are failing to give adequate educational opportunity to a very sizable portion of our population which is qualified to take advantage of these opportunities.

This point has been strongly emphasized, for example, by my friend, President Conant of Harvard University, in his appeal for education in a "classless society." He calls attention to the substantial portion of our secondary school graduates who have the undoubted ability to profit by a higher education but who are prevented from doing so either for financial reasons or because of a narrow perspective of opportunity, and he points out that all such cases represent definite failures to utilize effectively our potential human resources.

If we go back of higher education and consider the problem of our public schools, we realize how imperfect is our effort to educate our youth along the lines of the very great concept of public education. When a town dog-catcher or comfort station attendant commands a salary higher than that of a public school teacher, and when a very substantial portion of our public school teachers have to be engaged on an emergency substandard basis because of lack of applicants with full qualifications, we

realize that the utilization of personnel in the interests of our over-all economy and security leaves much to be desired. The development of scientists and technologists is only one part of this more general educational problem but it is an important part and at the present time it is one of the "bottlenecks."

I have called attention to some of the limiting factors which stand in the way of the most effective possible utilization of science for the insurance of our security. Funds, facilities and personnel are all intimately related aspects of this limitation, and I think it is clear that the removal of these limitations depends in the last analysis on public understanding of the matter and a sufficiently alert interest in these problems to bring about those actions which will permit their better solution. These actions involve primarily two things: more adequate and more permanently assured financial support on the one hand, and a public concern which will give increased opportunity, prestige and attractiveness to the educational, scientific and engineering professions on the other hand.

## Scientific Secrecy and Military Security

Now, in conclusion, I should like to discuss the subject of science and security from quite another angle—an angle based on an understanding of what security means when used in the narrow military sense.

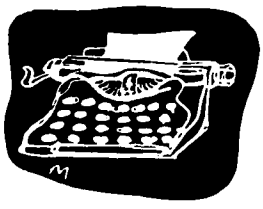
At all times, and especially in time of war, it is necessary to maintain a high degree of secrecy in certain matters, which, if known to the enemy, would give him an advantage and put us at a disadvantage. This secrecy applies, of course, to all types of military planning and preparations. Because of the enormously increased importance of modern scientific developments as applied to warfare, this secrecy has also been very important in connection with the design and contemplated use and even the very existence of new weapons. The atomic bomb is the outstanding recent example, but there are many others, such as the possibilities of bacteriological warfare, new types of airplanes, new methods of detection and destruction of enemy planes or submarines, various types of countermeasures against possible enemy actions, etc. I think no one can properly question the justification and high importance of maintaining adequate secrecy on these points. This fact has been so well recognized that in common parlance and in the public mind the word "security" has often come to be used synonymously with "secrecy." What I wish now to discuss is the relationship between security and secrecy, with especial reference to scientific developments which may be of military significance.

## A Balanced Policy Is Indicated

There are two aspects of security, just as there are the two aspects of warfare which we call offensive and defensive. While defensive measures and precautions have to be taken, it is a generally recognized principle that "the best defense is a strong offense." The same principle applies in the matter of security.

Our security in technological matters having to do with warfare rests fundamentally on our being as far as possible ahead of our unfriendly competitor. To be in this favorable position we should prevent our competitor from learning our secrets, which is the defensive aspect, and we should work actively to make significant advances in our own technology, which is the offensive aspect. Neither of these should be neglected. It is evident that if we proceeded actively with our technological developments, but at the same time published them broadcast everywhere, we would permit our competitor to keep pace with us at relatively little expense to himself. At the other extreme, if we should simply sit tight and hold on to our secrets, it would not be long before our competitor had forged ahead of us. Somewhere between these two extremes is the best procedure—and by best I mean the procedure which will give us the most advantageous relative position.

Unfortunately in this case secrecy and progress are mutually inimical, as is true of all progress in science whether for military purposes or otherwise. Science flourishes and progresses in an atmosphere of free inquiry and free interchange of ideas and the continual mutual stimulation of active minds working in the same and related fields. Any element of secrecy which is imposed on this activity acts like a brake to progress. It is for this reason that the most advantageous path between these extremes is difficult to define, and because of this difficulty I believe there is much misunderstanding and confusion in public thinking on the subject. It is much easier for the average citizen to understand secrecy than it is for him to understand the conditions necessary to scientific progress.



It is probably for this reason, among others, that there is such a furore at the present time about possible leaks of secrets, and all who are closely concerned with our scientific progress in military affairs are aware of the fact that the results of this publicity and of some procedures of official investigating groups have had seriously detrimental effects on our progress toward security through scientific research and development. It would be better to take the carefully calculated risk of allowing some confidential information to get out of our hands, if such a policy would enable us to advance our own science and art at a rate which a competitor cannot hope to equal, than to impose by regulation or public opinion a condition which seriously handicaps progress by rendering employment in these pursuits definitely unattractive to top-flight scientists and engineers who have plenty of other opportunities to turn their talents into more comfortable and usually more rewarding directions.

## Recent Trend Involves Danger

I am one of the large group of scientists and engineers who are strong advocates of national military preparedness at this time, but who are greatly worried over the detrimental effects, on our work for technological preparedness, of the barrage of publicity regarding alleged espionage and the charges which have been made against reputable scientists on the basis of hearsay and unsubstantial evidence. I confess that when I read what appears in the papers about some of these cases, I generally get the impression that the cases are very serious indeed and that the individuals concerned are very bad actors. This may actually be true in many cases. What bothers me, however, is that in the cases of individuals whom I have known personally and intimately over many years, my knowledge of the character of the men and of the circumstances on

which the charges are based convinces me of the very flimsy character of these charges and the great injustice which is being done to individuals concerned. I am only one of many hundreds, and perhaps thousands of scientists who find themselves in this situation.

What is most needed is to recapture in the public mind, and in the attitudes of the scientists who must do the jobs at hand, that spirit of confidence in and enthusiasm for their work with which we emerged from the war. At that time the public very properly applauded and supported the remarkable technological achievements which played so important a role in our victory. The scientists had great personal satisfaction in having been able to contribute thus substantially to our national effort. If that spirit is maintained we shall make great progress toward the further contributions of science to our national security. If the recent trend of suspicion and lowering morale continues, however, we shall be in really serious danger.

### Progress Requires Education

It is desperately important, in this period of international uncertainty, that the present trend be reversed and that the work of scientists and others who are engaged in efforts to promote our national security should again have the public support and commendation which they deservedly received at the end of the war when the public was made aware of their great contributions to our victory. Only then will the people who are so much needed in this work, and who wish to enter it from a patriotic motive, be enabled to do so with enthusiasm and not be forced to view it as something distasteful or dangerous and to be shunned.

This is far from the first time when misguided or uninformed public opinion has stood in the way of progress and security. From the minutes of a Select Committee of the House of Commons in Great Britain in 1879 appears the following quotation from a speech by a member of the London School Board:

"Geography, sir, is ruinous in its effects on the lower classes. Reading, writing and arithmetic are comparatively safe but geography invariably leads to revolution.

"The whole effect, sir, of extra subjects is to diminish the fierce virtues of an ancient people."

We can hope that time, education and better understanding can bring about gradually more intelligent consideration of our various public problems like the ones which I have described tonight. There is some evidence that we can make progress. Compare the present state of public opinion on scientific matters with the following statement which comes from the records of an Ohio school board in the year 1828:

"You are welcome to use the school room to debate all proper questions in, but such things as railroads and telegraphs are impossibilities and rank infidelity. There is nothing in the word of God about them. If God had designed that his intelligent creatures should travel at the frightful speed of fifteen miles an hour by steam, he would have foretold it through his holy prophets. It is a device of Satan to lead immortal souls down to Hell."

Unless we have a catastrophe we can hope that ultimately these difficult questions of public policy, which concern science and many other things, will receive a better understanding and handling than they have at present. But in some of the situations which I have mentioned the time may be short and it is important for this understanding to be exercised very promptly.

In conclusion, I can find no better way of epitomizing the various thoughts which I have expressed in this address than by quoting Pasteur, who said: "In our century science is the soul of the prosperity of nations and the living source of all progress. Undoubtedly the tiring discussions of politics seem to be our guide—empty appearances. What really leads us forward is a few scientific discoveries and their applications."

## The Committee on Un-American Activities Feels the Effect of November 2

The Congressional Elections of November 2 have led to the elimination of two Republican members of the Committee on Un-American Activities of the House—Vail of Illinois and O'Donnell of Pennsylvania. The chairman of the Committee, Representative Thomas (R. New Jersey) was re-elected, but his indictment on charges of payroll padding makes it unlikely that he will play an active role in the Committee. The anti-Truman attitude of Mr. Rankin, the ranking Democrat on the Committee makes it unlikely that he will be permitted to assume the chairmanship which will then probably pass to the less reactionary Representative Wood (D. Ga.).

These personnel changes, and the general attitude of the voters expressed in the election, make the hope justified that the investigating procedures of the Committee on Un-American Activities will become less objectionable than they have been under Mr. Thomas' chairmanship. We can hope that the still pending "Condon case" will be speedily and satisfactorily disposed of, and that the practice of casting aspersion on scientists and other intellectuals without sufficient public basis in fact and without chance of rebuttal in open hearing will be abandoned.

While it cannot be said that the November 2 vote was cast on the issue of constitutional freedom vs. arbitrary persecution, it is undoubtedly legitimate to infer from the results of this election that the "red spy scare" of the Thomas Committee has not had the effect on the minds of the voters which some Republican leaders hoped for, and many independent observers feared. The forces of obscurantism, which many observers at home and abroad saw as rising inexorably in the wake of the world war and under the impact of the "cold war" with the Soviet Union, has clearly as yet gained but little sway over the American mind.